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Some Echinocerei of New Mexico

PAUL CARPENTER STANDLEY

Among the commonest of the cacti that grow in the southern part of New Mexico are the scarlet-flowered *Echinocerei.* They are abundant upon the sandy mesas that lie above the valley of the Rio Grande and are frequently seen in the mountains that rise here and there above the mesas. They are never found in the valley of the river. To a botanist observing the plants it is evident that a number of different forms are represented, for the plants vary noticeably in habit, size, length and color of spines, and color and size of flowers.

The writer spent some time during the spring of 1907 in a study of these forms in an attempt to see how many species might be represented or whether all the forms found might not be modifications of one extremely variable species. The material for this study consisted of something over a thousand separate plants growing in the cactus garden of the New Mexico Agricultural College. These plants were collected mostly upon the mesa lying between the Rio Grande valley and the Organ Mountains. A few were brought from the Organ Mountains. Several plants from the type locality of *Echinocereus coccineus* were also examined. In addition to this living material, examination was made, through the kindness of Dr. William Trelease, of the Missouri Botanical Garden, and Dr. B. L. Robinson, of the Gray Herbarium, of the dried material in the herbaria of these institutions, including the type material of the three species here discussed. In addition to the types a number of other interesting specimens collected by the early botanical explorers, some of them in this same region, were examined.

As soon as the plants began blooming, about the middle of March, the study of them was begun. Measurements were made of over a thousand plants. These measurements included size and habit of plants, number of ridges, number and arrangement of spines in the areolae, length and color of spines, size and color of flowers, shape of petals, length of stamens, number and color of stigmas, and several less important details. These measurements were continued as the different plants came into flower, until a freeze the twenty-sixth of April killed all the flowers and buds. On account of this freeze it was impossible to make any study of the fruits, characters of which may be of value in separating the species.

A number of species, all of them separable with difficulty, have been named in this group of *Echinocerei.* After some study of the type materials the writer decided that three reasonably distinct species were represented by the material in the garden, *E. polyacanthus* Engelm., *E. coccineus* Engelm., and *E. conoideus* Engelm. In order to facilitate a comparison between these three species, after careful study of the plants as a whole, a selection was made among the plants in the garden of one hundred individuals to represent each of the three species. The plants selected were those considered to be most typical of the species and were easily separated from the others and from each other, although there were many plants in the garden that it would have been difficult to refer to any of the species with any degree of certainty. Here there was obviously room for error, but this must always be the case in any determination of species. These three lots of plants are those hereafter referred to as *E. coccineus*, *E. polyacanthus*, and *E. conoideus*.

The measurements of these selected plants, together with the measurements of the entire lot, were then tabulated and an attempt made at a graphical statistical study of them. Curves were plotted illustrating the variation in each lot and a comparison was made of the four sets of curves in order to see whether any of the characteristics exhibited by any one lot of plants were peculiar to that species alone. The results were rather disappointing. Out of the whole number of living plants studied it was impossible to distinguish more than four species, while any one glancing over the plants and noting the great variation in color and size of spines and flowers would have guessed that at least a dozen distinct forms were represented. There is even some doubt whether at least three of these so-called species may not be forms of a single species.

The greatest difficulty encountered was the finding of some constant character or group of characters by which to differentiate the species. The extremes of variation of a given character upon any single plant were farther apart than the means of the same character for two adjacent species. Neither was there any concurrent variation of characters found. Instead, intergrading forms can almost always be found between any two extremes of a given character. *E. polyacanthus*, for instance, seems to possess forms of spines that connect or lie midway between those of *E. coccineus* and *E. conoideus*. Careful study was made of the arrangement of the spines, color and shape of flowers, and stamens, and stigmas, in the hope that some character would be found which would be constant in one form, but no such peculiarity was found, with the possible exception of the spines. The curves showing graphically the variation of separate characters, when compared, showed plainly (1) the lack of concurrent variation, (2) the presence of intergrading forms, and (3) the overlapping of certain characteristics in the selected lots of plants. The different distinguishable characters were combined in almost every imaginable way upon the different plants in the most bewildering manner.

The best characters by which to separate the plants are probably those of the spines, taking them as a whole. Their stoutness, length, color, and arrangement furnish a means of distinguishing some of the forms, although even this is far from being a satisfactory one. In the plant which is our conception of *E. coccineus* the spines are light-colored, usually white or straw-colored; they are comparatively short and slender. In *E. conoideus* they are very long and slender; in most cases they are somewhat angled and more or less deflexed; their color is darker than in *E. coccineus* although it varies considerably in different plants. In *E. polyacanthus* the spines are midway in length between those of *E. coccineus* and *E. conoideus*, usually much longer than those of the former species and frequently as long as those of the latter; the spines are stouter than those of the other two species, and are ordinarily terete, rarely somewhat angled near the base; the color is quite variable, ranging from almost white to dark-gray or almost black; the spines, too, are more abundant, covering the plant more closely. The arrangement of the spines seems to be the same in all three species.

In many of the descriptions of this group the color of the spines is given as white, changing to ashy-gray or dark-gray. No such change was observed in any of the plants examined. Indeed, the young spines are often darker in color than the older ones. The spines at the base of the plant are frequently discolored by soil and water and this may have been the foundation for the statements in the descriptions mentioned.

The spines in these *Echinocerei* occur in areolae along the ridges of the plant. The arrangement of the spines in the areolae varies slightly in different plants and sometimes in the same plant. There are usually four central spines, sometimes more, which are commonly longer than the others. Around these, about the edge of the areola, are a number of radials. For convenience I have divided these into three groups. At each side of the areola are three or four long spines which I have called laterals. Above these are two or more very small spines which are often deciduous with age; these are the superior radials. Below the laterals are three or four spines, longer than the superior ones, which may be called inferior radials.

In the whole lot of plants examined the length of the central spines ranged from 14 to 81 mm. The length in the majority of cases lay between 20 and 40 mm. Even on a single plant there may be a remarkable variation in the length of the centrals. On a plant of *E. coccineus* the centrals, 102 in all, were measured. The length varied from 12 to 40 mm. with the chief mode of the curve at 24 mm. On a plant of *E. conoideus* it would be possible to find an even greater variation in length.

The length of the superior radials in the entire lot of plants ran from 4 to 22 mm. The greatest maximum was at 8 mm. The number of spines exceeding 13 mm. in length was very small. In *E. coccineus* the variation was from 5 to 13 mm.; in the other two species the length varied from 5 to 18 mm.

The length of the lateral radials ranged from 8 to 35 mm., with the principal modes of the curve at 18 and 21 mm. In *E. coccineus* the lengths varied from 10 to 24 mm., with modes at 16 and 20 mm.; in *E. polyacanthus* from 10 to 27 mm., with modes at 15 and 19 mm.; and in *E. conoideus* from 11 to 32 mm., with modes at 17, 20, and 24 mm. These lateral spines, as well as the other radials, are sometimes reflexed rather closely against the ribs of the plant, and in other cases more spreading. This character, however, seems to have no constancy.

In the inferior radials the length was from 9 to 36 mm., with the chief mode of the curve at 15 mm. In *E. coccineus* the length ranged from 9 to 23 mm., with modes at 13 and 16 mm.; in *E. polyacanthus* from 10 to 28 mm., with modes at 15 and 19 mm.; and in *E. conoideus* from 10 to 31 mm., with the main mode at 20 mm.

The distances between the areolae and between the ribs were measured because the apparent spininess of the plant is largely dependent upon these distances. It depends not upon either alone, but upon both taken together. The areolae may be very close to each other but the plant does not appear densely spiny because of the distance between the ribs and vice versa. The length of the spines, of course, is of importance in producing this effect of spininess. No satisfactory results were obtained from these measurements. As a rule, plants of *E. polyacanthus* seem more spiny than those of either of the other two species, and *E. conoideus* rather more so than *E. coccineus*.

The number of ribs is not important for it seems to vary equally in all three species. On a single plant on different branches the number of ribs sometimes varies from ten to twelve. Ten is the most common number.

The length of the flowers ran from 39 to 90 mm. The largest flowers were observed on plants of *E. conoideus*; but the number of plants with large flowers was small, so that this is probably not necessarily characteristic of the species. The size of the flowers depends somewhat upon the amount of water the plant receives. The plants that had been recently transplanted and had not received so much water as the others, produced flowers that were noticeably smaller.

The shape of the flowers is not the same on all plants. On some the flower is long and trumpet-shaped, gradually widening outward; on others the petals and sepals spread abruptly from about the middle of the flower. The shape of the petals, too, varies. In about forty flowers out of seven hundred the petals were retuse at the apex. In the others the apices were broadly obtuse. In some cases the petal narrows very gradually from the apex toward the base; in others the petal is very broad near the apex and narrows abruptly near its middle, giving it a broadly spatulate outline. The petals measured ranged in width from 6 to 21 mm. The number of petals is subject to some variation: there are usually from two to three complete whorls of the perianth, but in some flowers one finds about four, and in others scarcely more than a single whorl.

The flowers exhibited quite a range of color. In most specimens the upper part of the petal is deep-scarlet or orange-scarlet of various shades (RRO to RO1 and RO2, Prang Color Chart.) The color of the base of the petals is much lighter, yellowish-white, pale-yellow, greenish-yellow, pale orange-scarlet, rosy-white, or even pure-white. Other flowers have the upper part of the petals of a rose-color, passing into white at the base. Many of the flowers that are at first orange-scarlet or deep-scarlet become rose after a few days; but others are rose-colored when the flowers first expand. In a few flowers there was a decidedly purplish tint but this is rare. These color characters seem to vary without any relation to the other characters of the plants.

The number of the flowers upon the plant varies but little. The taller plants usually have a larger number of flowers than the smaller ones. In the three older species the flowers are lateral, mostly produced near the summit of the plant, each from the upper side of an areola. In the new species the flowers usually appear abundantly all over the plant, even from near the base.

The plants of these species are cespitose in habit, having anywhere from one to ten branches. Larger plants are rare. The mountain form, *E. coccineus*, is usually found as a plant of only a few stems. Sometimes, however, plants of this species form large hemispherical masses consisting of more than a hundred stems.

The length of stamens varies in different plants, seemingly without regard to the other characteristics of the plant. In some flowers the stamens are hardly more than half as long as the style; in others they are only a little shorter than the style, while in most of the flowers they reach about to the stigmas. In a few flowers the stamens were even longer than the entire pistil. The color of the stamens is about the same in all cases, the anthers a deep rose-purple, the filaments white, sometimes rose-colored near their junction with the anthers.

The number of stigmas is ordinarily eight, nine, or ten. Sometimes it is as low as four or five, while again it may reach thirteen. The color of the stigmas is usually a dull yellowish-green, but in some plants it is a bright chlorophyl-green. Sometimes the stigmas are long and slender; stigmas of this kind are usually yellowish-green; when they are short, they are thick and stout and the color is more likely to be bright-green.

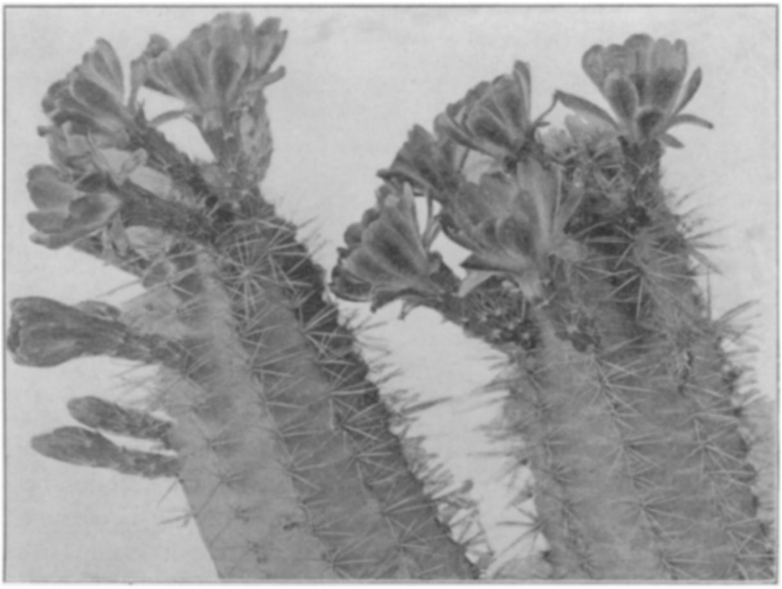

FIG. 1. Plant of *Echinocereus polyacanthus*. About one-third natural size. This plant is not quite so spiny as the typical form of the species.

In the beds composed of these three species several plants were noticed, which on account of the color of their spines, number and arrangement of the spines in the areola, and shape and size of flowers, were quite different from any one of the three species discussed here. They seemed rather to belong to some other group of *Echinocerei* although on closer study they were found to be as closely related to this group as to any other. After careful examination these plants seemed to be worthy of description as a new species and a description is added here. There also follows a discussion of the synonymy of the group and a list of a few of the herbarium specimens examined.

Of all the characters that have been discussed here there is no single one that can be depended upon absolutely for the separation of species. Those of the spines, especially the centrals, are probably of more value than any others. For the separation of the four species I would offer the following key based upon the spines :

Centrals mostly six ; flowers small ; petals almost acute. *E. neo-mexicanus.*
Centrals three to five, mostly four ; flowers larger ; petals broadly obtuse.
  Centrals slender, white or straw-color, 14–40 mm. long, plant depressed at top. *E. coccineus.*
  Centrals stout, terete, usually gray or dark-gray, 15–50 mm. long, plant usually obtuse. *E. polyacanthus.*
  Centrals slender, more or less angled, somewhat curved, usually ashy-gray, 25–80 mm. long, plant rather acute or conical at the top. *E. conoideus.*

ECHINOCEREUS COCCINEUS Engelm. Wisliz. Rep. 9. 1848

Cereus coccineus Engelm. Pl. Fendl. 50. 1849.
Cereus phoeniceus Engelm. Synop. Cact. 284. 1856.
Cereus aggregatus Coult. Cont. Nat. Herb. 3 : 396. 1896.

Mammillaria aggregata Engelm. Emory's Rep. 155. 1848, may be the same species. There is, however, no type specimen existing of this species, and although the original description is accompanied by a drawing of the plant, this drawing is of such a general nature and the description is so brief that it is impossible to tell to just what it refers. The plant illustrated might be either of the species discussed here. In this difficult group of plants it is well to accept only those species of whose identity we are reasonably certain. Consequently it is better to neglect this name for one of which we still have the type specimen.

Specimens examined :

NEW MEXICO : Santa Fé, 1846, *Wislizenus* (type) ; Santa Fé, *Fendler 272 ;* Burro Mountains, Grant County, May 20, 1903, *O. B. Metcalfe 82* (the sheets that I have seen, at least) ; Upper Pecos, Oct. 13, 1853, *J. M. Bigelow ;* Anton Chico, 1853, *Bigelow ;* also numerous specimens in the cactus garden of the Agricultural College, collected on the mesa west of the Organ Mountains and in the Organ Mountains; several specimens forwarded in 1907 from Santa Fé by Mr. Arthur Boyle. ARIZONA: San Francisco Mountains, Dec. 27, 1853, *Bigelow;* Fort Whipple, May 3, 1865, *Coues & Palmer;* in the vicinity of Flagstaff, May 31, 1898, *D. T. MacDougal.* COLORADO: Wet Mountain Valley, May 17, 1873, *T. S. Brandegee 541.*

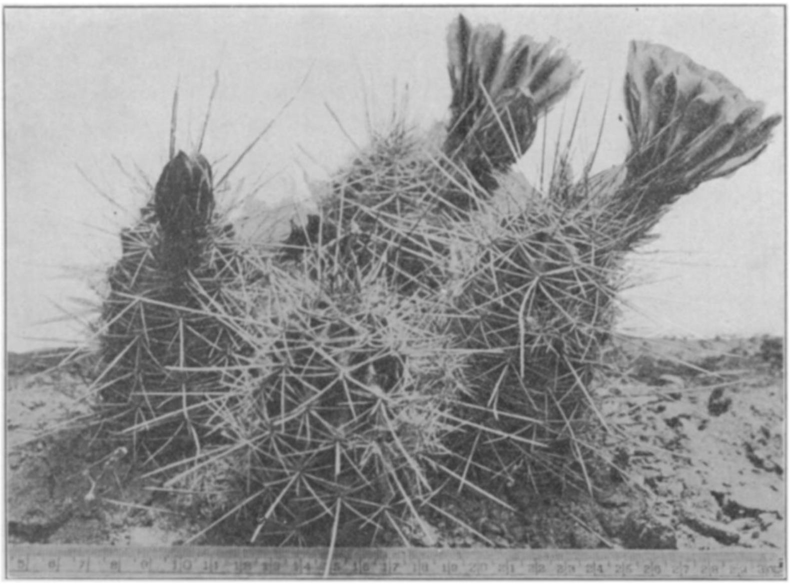

FIG. 2. Plant of *Echinocereus conoideus.* About one-third natural size (the rule indicates the reduction). The typical form of the species.

ECHINOCEREUS POLYACANTHUS Engelm. Wisliz. Rep. 20. 1848
Cereus polyacanthus Engelm. Pl. Fendl. 50. 1849.

Specimens examined:

CHIHUAHUA: Cosihuiriachi, 1846, *Wislizenus* (type); on hills near Paso del Norte (now Ciudad Juarez), Apr. 9, 1885, *C. G. Pringle 253.* NEW MEXICO: Las Cruces, May 2, 1895, *E. O. Wooton;* also many specimens in the cactus garden of the Agricultural College, collected upon the mesa west of the Organ Mountains. ARIZONA: On dry ledges in the Santa Rita Mts., Apr. 30, 1881, *C. G. Pringle;* Prescott, May, 1876, *E. Palmer* TEXAS: El Paso, *Thurber 191* and *192; Wright 41,* of 1852 collection (in part); El Paso, 1851, *Wright 228* (in part).

ECHINOCEREUS CONOIDEUS Engelm. Rümpl. Forst. Handb. ed. II, 807. 1886*

Cereus phoeniceus conoideus Engelm. Synop. Cact. 284. 1856.

Cereus conoideus Engelm. Pacif. R. R. Rep. **4**: 36. 1856.

Cereus Roemeri Muhlenpf. Coult. Cont. Nat. Herb. **3**: 395. 1896.

Echinocereus phoeniceus conoideus (Engelm.) Schumann, Gesamtbeschreibung der Kakteen, 283. 1903.

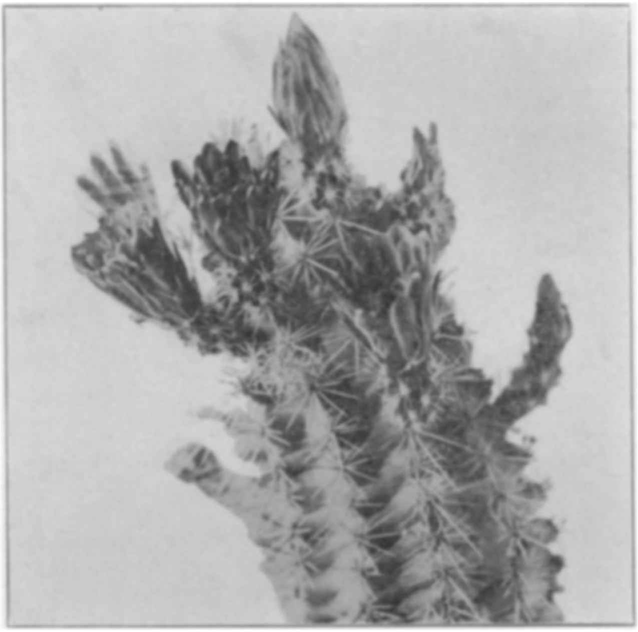

FIG. 3. Plant of *Echinocereus neo-mexicanus*. About one-third natural size.

Cereus Roemeri Muhlenpf. Allg. Gart. Zeit. **16**: 19. 1848 (not Engelm.) may be the same plant but no type of it is preserved and the description is not sufficient to identify it, although it seems to point towards this species.

Specimens examined:

NEW MEXICO: Anton Chico on the Pecos, Sept. 27, 1853, *J. M. Bigelow* (probably the type); Fort Wingate, 1869, *E. Palmer*

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*Dr. Engelmann never published this combination but it is credited to him in the work cited.

73; five miles east of Hillsboro, July 12, 1904, *E. O. Wooton 3004;* also many plants growing in the cactus garden of the Agricultural College, brought from the mesa west of the Organ Mountains and from the Doña Ana Mountains. ARIZONA: Fort Whipple, 1865, *Coues & Palmer.*

Echinocereus neo-mexicanus sp. nov.

Plant ovate-cylindrical, cespitose with few stems, obtuse at apex, 18–25 cm. high, about 7 cm. in diameter, glaucous-green: ribs 11–12, obtuse, rather low, 15–18 mm. apart, tuberculate; areolae 10–15 mm. apart, oval, large: spines rather slender, terete, spreading from the plant; centrals mostly 6, stouter than the radials, rigid, spreading, the lowest one always very light-colored, yellowish, almost white, the others reddish, giving the plant a distinctly reddish and variegated appearance; superior radials 2–5, slender, 4–7 mm. long, unequal, almost white; lateral radials 8, four on each side, spreading, 11–15 mm. long, the lowest longest, of the same color as the superior radials; inferior radials 3, spread-

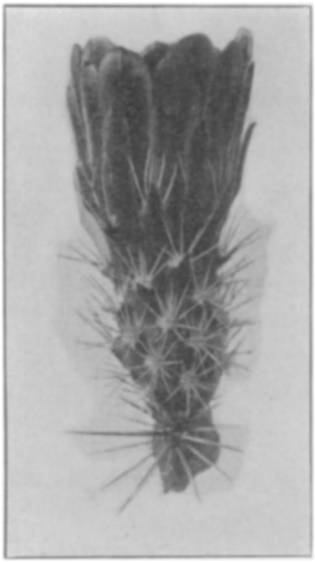

FIG. 4. Exterior view of flower of *Echinocereus neo-mexicanus*. Actual size.

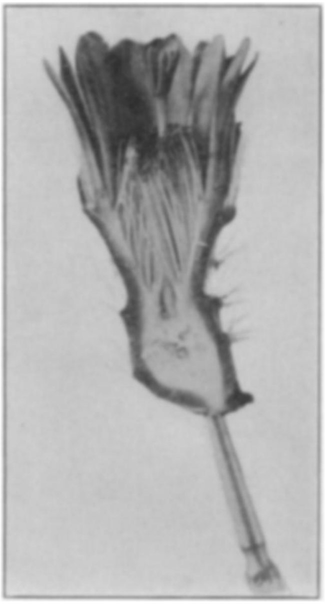

FIG. 5. Longitudinal section of flower of *Echinocereus neo-mexicanus* shown in Fig. 4.

ing, about as long as the laterals and of the same color: flowers numerous, usually produced all over the plant, a peculiarity in which the plant differs from the other species here discussed; flowers about 50 mm. long, 25–30 mm. in diameter, narrow, not spreading as in the other species; petals firm in texture, almost or quite acute at the apex, upper part of the petals bright-scarlet, lower part greenish-yellow, petals about 6 mm. wide; tube of flower covered with abundant, spreading, rather long, bristle-like spines; stamens about one half as long as the style, anthers rose-colored, filaments white or tinged with rose; stigmas about 7: fruit not seen.

The variegated appearance of the spines, the distribution of the flowers on the plant, the small, contracted flowers, make this species distinguishable. The type is *Standley 383* in the herbarium of the Missouri Botanical Garden, in the Gray Herbarium, and in the National Herbarium, all the specimens being taken from the same plant. A number of the plants are still growing in the College cactus garden; they were brought from the mesa west of the Organ Mountains, Doña Ana Co., New Mexico.

HERBARIUM OF THE NEW MEXICO AGRICULTURAL COLLEGE.